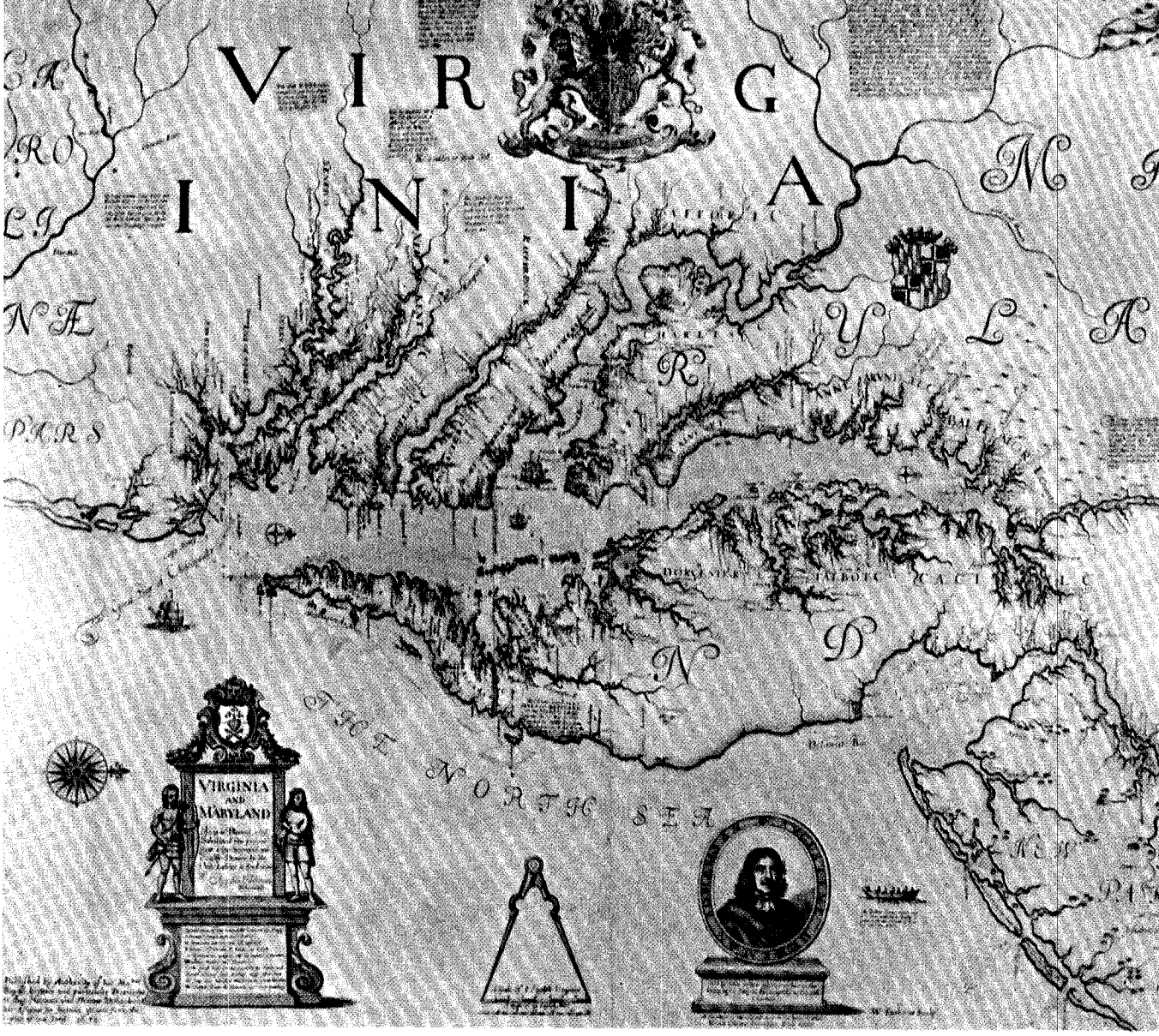
THE CHESAPEAKE AND DELAWARE CANAL

As the first stone boats were discharging their cargoes in Breakwater Harbor, water was being let into the Deep Cut of the new Chesapeake and Delaware Canal. The date, 4 July 1829 marked the culmination of an arduous effort which had begun on 15 April 1824. The inaugural celebration of this "Great National Work" was held 17 October 1829. Regrettably absent from the ceremony was the first "Public Works" President, John Quincy Adams, who had participated with such evident relish and oratorical flourish at other canal inaugurals: the Chesapeake & Ohio (ground breaking 1828) and the Erie, greatest of American canals, at its completion on 2 November 1825.

Although the cutting of the canal required just over five years, its consummate goal of joining the waters of Chesapeake and Delaware Bays had been anticipated for more than a century and a half. A colorful manuscript map representing Virginia and Maryland "*as it is planted and inhabited this present year 1670, surveyed and exactly drawne by the only labour & endeavour of Augustin Herrman, Bohemian*" was for sale in 1673 at the shop of the king's hydrographer in London. The author, whose engraved portrait appears near the mouth of Delaware Bay, was among the first to suggest the considerable navigational and commercial benefits to be derived from a canal cut across the narrow neck of the peninsula. A glance at this map, one of the first of any accuracy to show the area, would make and indeed must have made this possibility apparent to many; subsequent more exactly drawn maps continued to do so.

In 1764 the American Philosophical Society of Philadelphia proposed that route studies be undertaken, with a view to establishing closer contact between the Chesapeake Bay country and Philadelphia. An attempt made by Pennsylvania in 1784 to interest Delaware and Maryland in a canal project was met cooly. Opposition was exerted by Baltimore interests who suspected Pennsylvania of attempting to attract the trade of Maryland and the Susquehanna River to Philadelphia, and away from the port of Baltimore. In 1799 Pennsylvania's proposals were more favorably received, and on 7 Dec. the State of Marlyand drafted an act to incorporate a company "for the purpose of cutting and making a canal between the River Delaware and the Chesapeake Bay." Books were opened 1 March 1800 for a $500,000 stock subscription. Four-fifths of the capital stock was taken within a year.

By 1802, the Chesapeake and Delaware Canal Company was incorporated in the three states and sufficient capital stock had been sold to justify hiring engineers to begin surveys. Regrettably, both progress and available funds were short. Stockholders learned that the cost of surveys and a feeder, plus fees for water rights along the route had already taken $100,000. Nothing had yet been done on the main canal which, it now appeared, would cost considerably more than had been estimated. An appeal to the three states in 1805 elicited favorable endorsements but no financial aid. At this time American engineering was in its infancy, but the stirrings of an awakening industrial giant were being felt throughout the land. Necessity prodded native genius to accomplish feats beyond the scope of its training. These early planners and builders possessed a bare minimum of theo-



retical and practical knowledge, scarcely enough to prepare them for the mammoth projects which they brashly undertook.[1] Their cost estimates could be wildly inaccurate—frequently 300 per cent too low, as in the case of the Chesapeake and Delaware Canal.

The directors of the Canal Company exerted extensive efforts to persuade the National Government to support the canal as a vital link in a system of internal improvements. From the logic of geography they argued that such a canal would surely lead to the building of the long-proposed canal across New Jersey, the Delaware and Raritan Canal, and to the extension of the Dismal Swamp Canal down to the bays and inlets of North Carolina. Economically, it was obvious that a great traffic would ensue between North and South in the exchange of mutually needed products at ever-decreasing prices. Boatmen at the head of Chesapeake Bay would be separated from the Delaware only by 21 miles of Chesapeake & Delaware Canal instead of 500 miles by sea route around Cape Charles. Forty-three miles of canal via the Delaware and Raritan would save 300 miles and the risks of the open sea off Cape May.

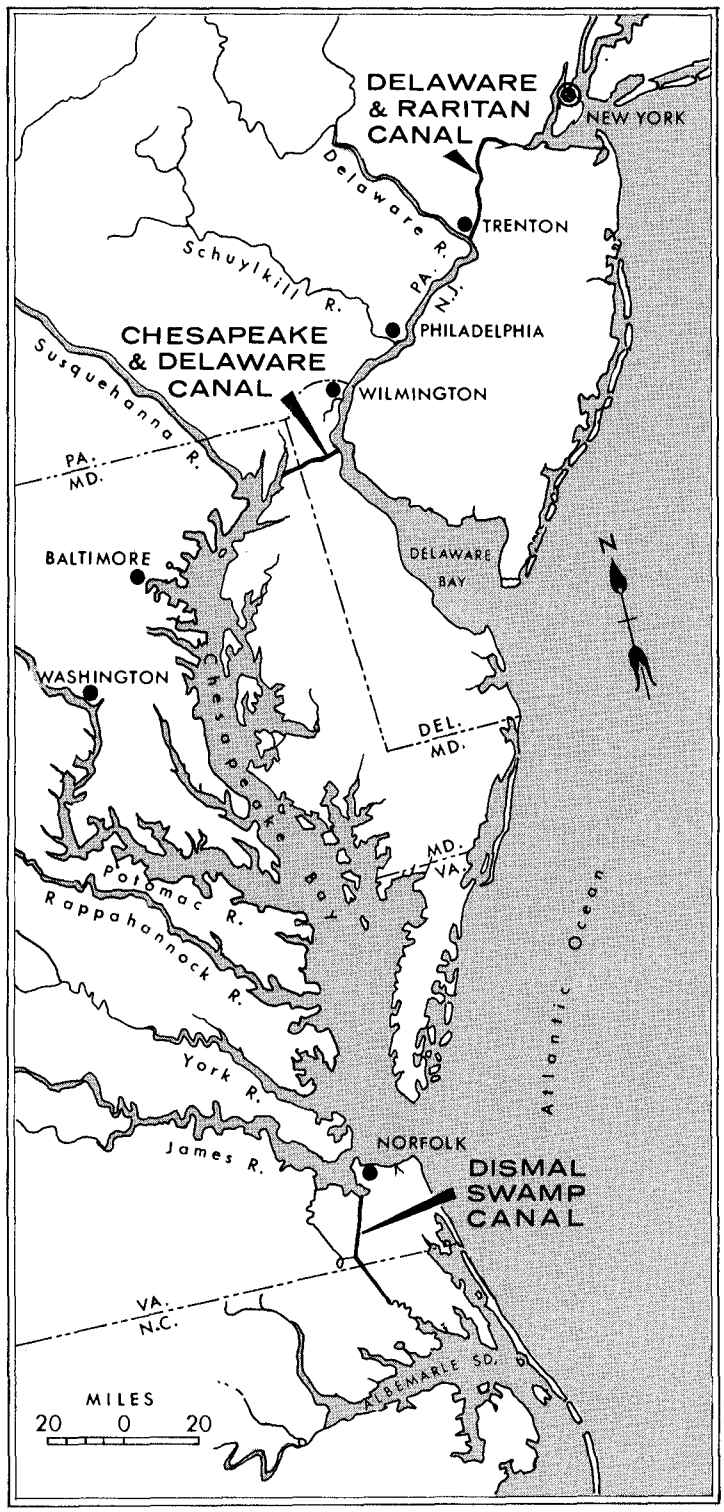
These and other persuasive arguments brought no immediate action from Congress. In 1807 that still indifferent body approved examination of the matter by the Secretary of the Treasury. Mr. Gallatin[2], ardent patriot and expansionist, gave a full year to the

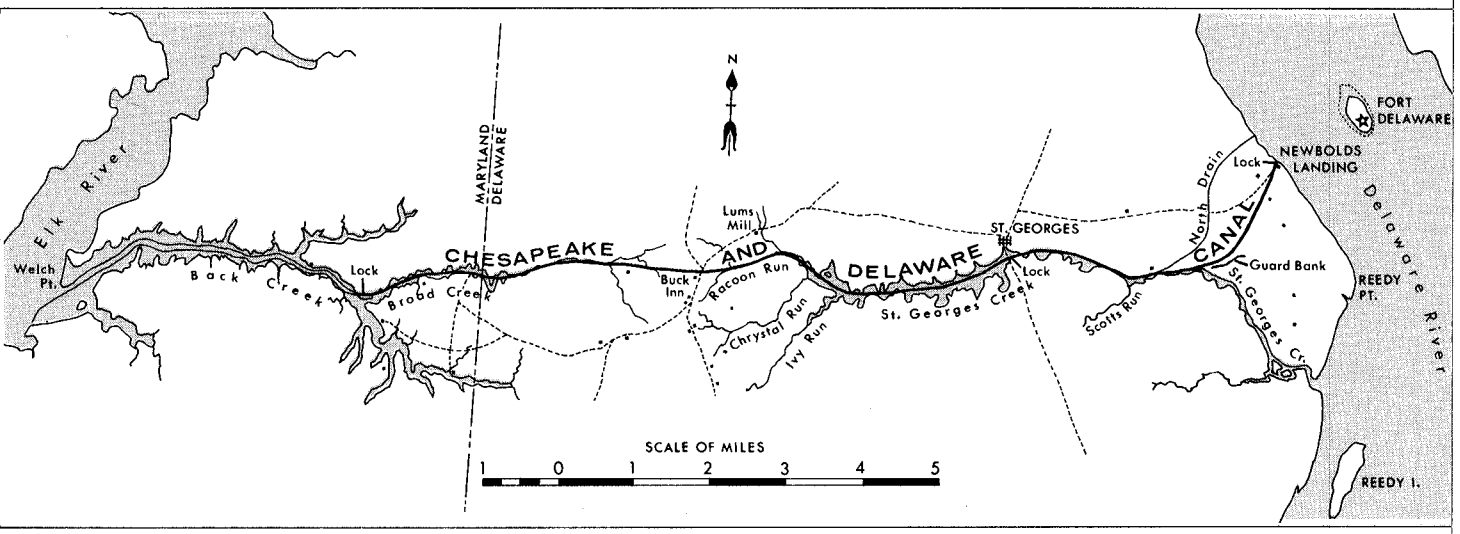
Augustine Herrman's map of the Delmarva Peninsula, dated 1670, is oriented with North to the right. Herrmann acquired 10,000 acres in Cecil County, Maryland and named it "Bohemia Manor"; he was among the first to survey the area and to advocate a cross-peninsula waterway.

—Cecil County Historical Society, Elkton, Maryland

survey, which resulted in the historic Report on Roads, Canals, Harbors and Rivers presented on 4 April 1808, a document at once comprehensive, imaginative and prophetic. It outlined not only the communications needs of the times but also envisioned future trends and developments. It recommended: the creation of an inland waterway from Massachusetts to North Carolina; development of eastern rivers for navigation linked to midwestern rivers by a network of turnpikes; and the construction of canals to connect the Great Lakes to the St. Lawrence River and the Eastern Seaboard. The Chesapeake and Delaware Canal was among the internal improvement projects for which federal aid was specifically recommended. Bills for the purpose introduced in 1810 were defeated by both Houses.

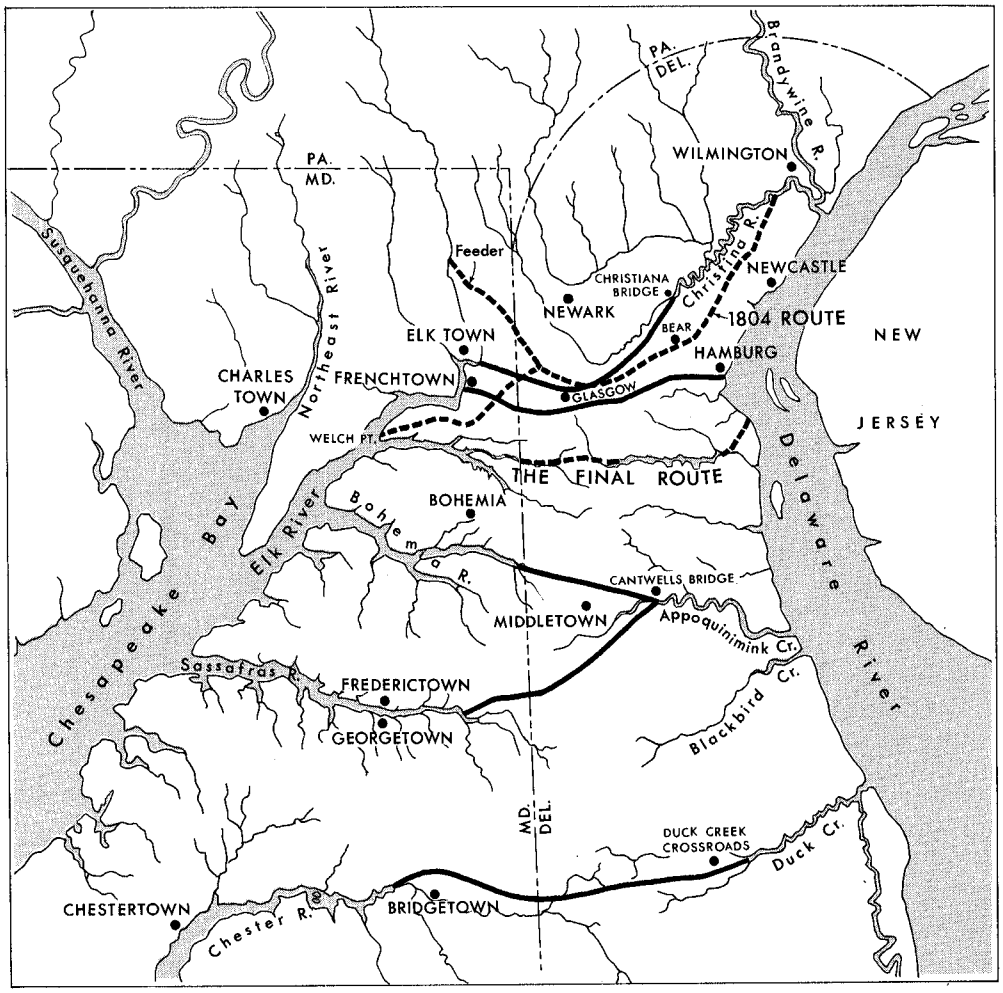
A dozen years passed before an effective move was made to revive the Canal Company and get the work underway. A new board of directors was elected in 1822 and Benjamin Wright, a former frontier county judge, was engaged as chief engineer. Judge Wright was one of the three principal engineers in charge of construction of the Erie Canal. That great work in its fifth construction year was justly causing concern to Pennsylvanians that New York would preempt trade with the west. Canal mania, which would culminate in the thirties, was beginning to gather momentum. Pennsylvania, already committed to vast internal improvements of her own, deemed the Chesapeake and Delaware project sufficiently important to subscribe the sum of $100,000. The State of Maryland subscribed $50,000 and Delaware $25,000. With an additional $450,000 from the Federal Government and

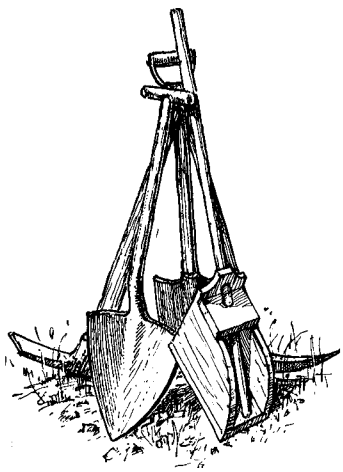




The final route connected Back Creek with St. Georges Creek and for eight years utilized natural stream flows for its water supply. The original map upon which the above is based was drawn before the terminal towns, Delaware City and Chesapeake City, were established.

The map below is adapted from one drawn by Francis Shallus in 1799. The heavy solid lines trace five proposed routes which had been surveyed prior to that year. A sixth route, surveyed in 1804, proposed linking Elk River at Welch Point with Christina River at Mendenhall, just below Wilmington; digging was begun on the feeder, but was abandoned in 1806. The final route was determined after 1822.

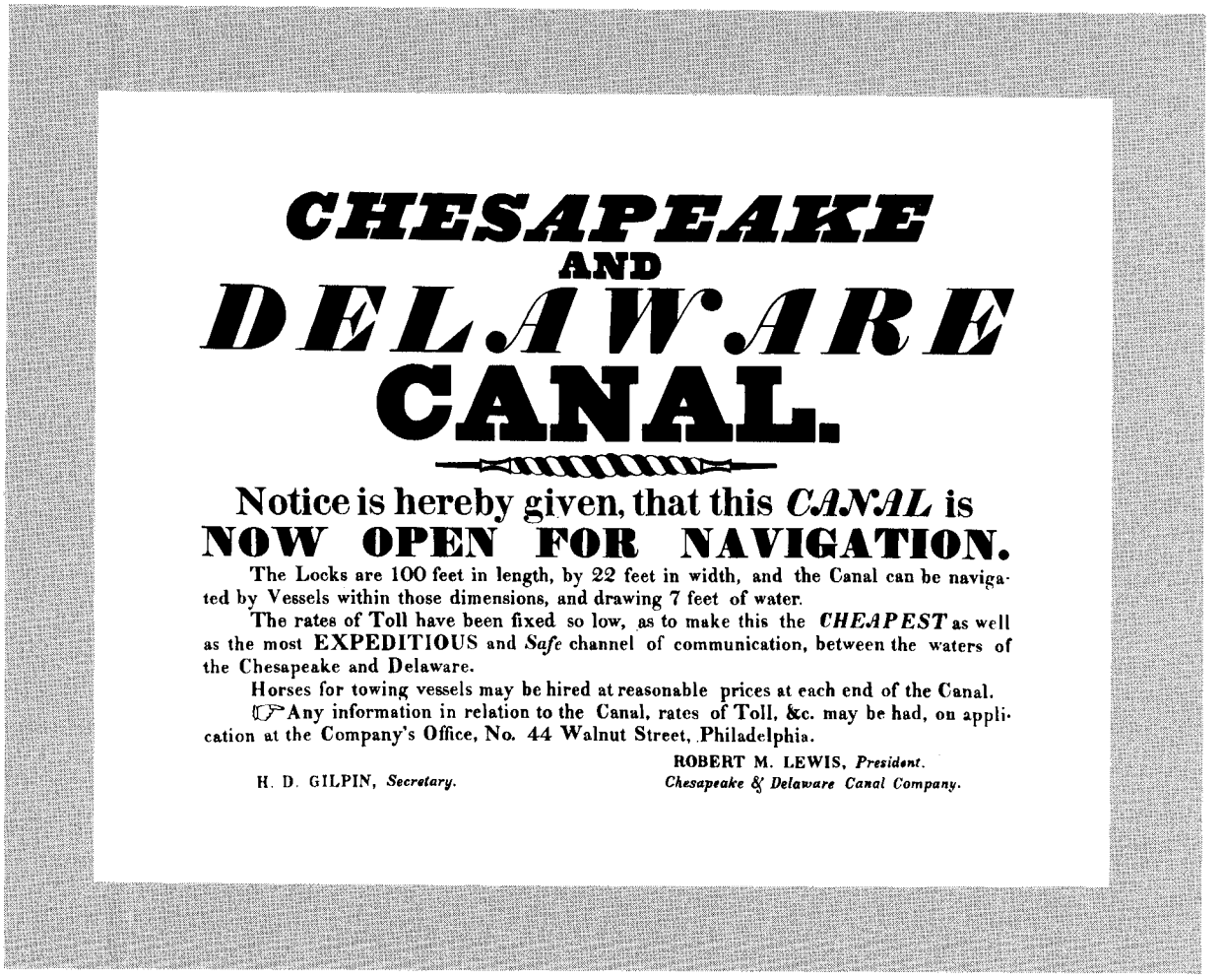




nearly half a million from public subscription, the work was reopened in 1824 with a capitalization of $1,000,000. New cost estimates valued the project at $1,239,159, a sum twice the original estimate but barely half the amount eventually required for its completion.

A new survey had been made in 1822 but its route was opposed by John Randel, Jr., newly-appointed to supervise the work while Judge Wright was busy with the Erie. Randel, another Erie Canal product, had run his own levels and decided that a route farther south would provide a more adequate water supply and would require less excavation and less lockage. The Company directors, with an eye to the budget and confident in the adequacy of the existing survey, disagreed. Randel was judged incompetent and discharged. The young engineer brought legal action against the Canal Company and won his case, collecting damages and realizing the satisfaction of seeing his route adopted.

Other young men came down from the Erie "School of Engineering" to lend their skills to the C & D; among them, Canvass White, Judge Wright's protege and assistant, who had walked the canals of England for two years, making notes and sketches for use in the Erie construction. White made the first discovery of domestic hydraulic cement deposits in Madison County, N.Y. His "waterproof lime"



CHESAPEAKE
AND
DELAWARE
CANAL.

Notice is hereby given, that this *CANAL* is NOW OPEN FOR NAVIGATION.

The Locks are 100 feet in length, by 22 feet in width, and the Canal can be navigated by Vessels within those dimensions, and drawing 7 feet of water.

The rates of Toll have been fixed so low, as to make this the *CHEAPEST* as well as the most EXPEDITIOUS and *Safe* channel of communication, between the waters of the Chesapeake and Delaware.

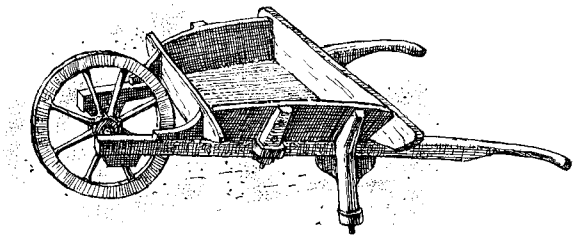
Horses for towing vessels may be hired at reasonable prices at each end of the Canal.

☞Any information in relation to the Canal, rates of Toll, &c. may be had, on application at the Company's Office, No. 44 Walnut Street, Philadelphia.

ROBERT M. LEWIS, *President.*
Chesapeake & Delaware Canal Company.

H. D. GILPIN, *Secretary.*

1829 Broadside announcing the Canal's Opening.
—Historical Society of Delaware



The old canal through the Deep Cut looking westward from Summit Bridge about 1860. The towpath, on the right, was frequently blocked by slides from the steep unstable slopes.
—Historical Collection, Philadelphia District

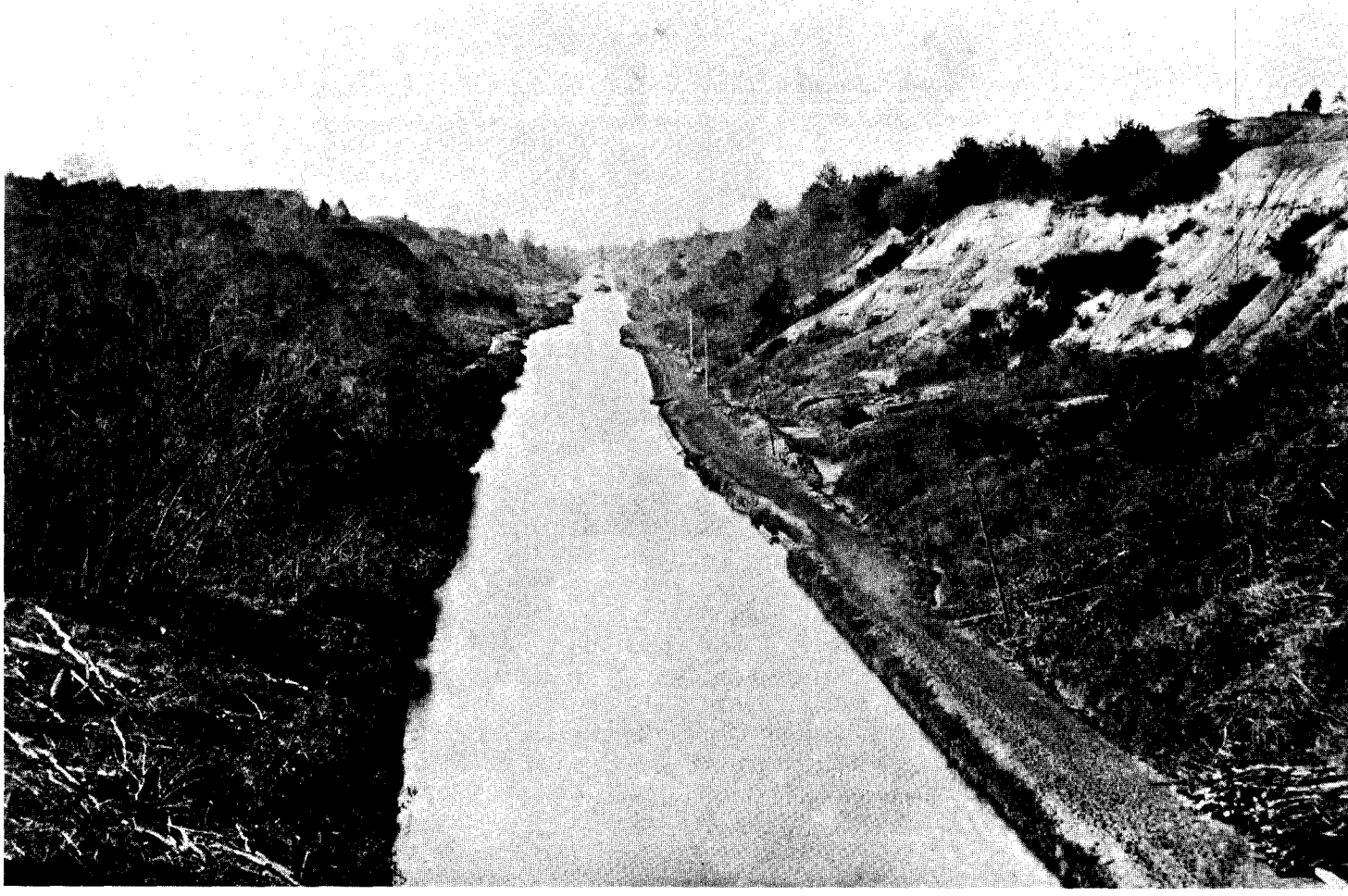
was the mortar that effectively bonded the masonry of the Erie locks and revetments. Physically frail, he spread his energies among all of the notable canal projects of the East, dying at 44. Nathan Roberts, surveyor become engineer-of-necessity, who devised the spectacular five-level, double lock structure at Lockport, N.Y. also contributed his experience to the Delmarva cutting.

Compared to the Erie, the Chesapeake and Delaware Canal seems a minor undertaking. Its length was 13-5/8 miles, the Erie 363 miles. From Albany to Buffalo boats were raised through 83 locks for a total lift of 675 feet. Summit level of the C & D required a maximum total lift of only 16 feet employing a tide lock at each end and one other lift lock. Neither these figures nor the relative prism dimensions[3] give reliable clues to the cost-per-mile divergencies of the two projects. The total cost of $2,250,000 made the Chesapeake and Delaware the most expensive canal of its time. One of the shortest, its cost-per-mile was 8.5 times that of the longest, the Erie Canal. Canals were expensive despite ready availability of low cost labor and materials. Here are cost-per-mile figures for original construction of most of the early canal projects:

Erie	$ 19,255.49
N.Y. State Canals, Average	17,367.57
Delaware & Hudson	20,655.00
Lehigh	33,610.00
Pennsylvania State Canals	22,113.00
Schuylkill	16,741.26
Union	18,518.51
All New England Canals	12,838.71
Middlesex Canals	19,000.00
Ohio & Erie	10,000.00
Miami & Erie	12,000.00
Chesapeake & Delaware	165,000.00

Manpower was the prime mover on the C & D as on all other early nineteenth century construction. Excavation was accomplished by the muscle power of more than 2,500 men using pickaxes, hand shovels and some primitive lifting devices. In some sections horses were put to use, drawing man-guided bucket scoops. Excavation with explosives was minimal, the great obstacle being instability of terrain rather than massive resistance of rock. The course of the channel ran westward from its eastern terminus at the Delaware River across eight miles of low lying plain, of which more than a mile was tidal marsh. Borings made in this section to a depth of 54 feet disclosed a foundation consisting principally of massive deposits of water-bearing sands interspersed with strata of tough blue clay—but no rock. From mile eight to mile eleven cutting penetrated a low ridge which ran down the middle of the peninsula. Here was dug the famous "Deep Cut" regarded in its day as "one of the greatest works of human skill and ingenuity in the world."

The great volume of material removed from the Deep Cut was probably the single item most responsible for the canal's enormous cost. The heterogeneous formation of boulders, gravel, sand and marls was underlaid by thick beds of sand bearing copious flows of water, alternating with tough clay strata. The overburden was laboriously excavated in barrels dragged up over the 90-foot summit by rope. The long slopes, intended to be pitched 1-1/2 on 1, continually sagged and slid. East of the Deep Cut, materials had to be imported for construction of the banks 10 to 20 feet higher than the existing terrain. The agonizing reverses caused by instability of the geologic base are cryptically described in the 1829 commemorative tablet which may be



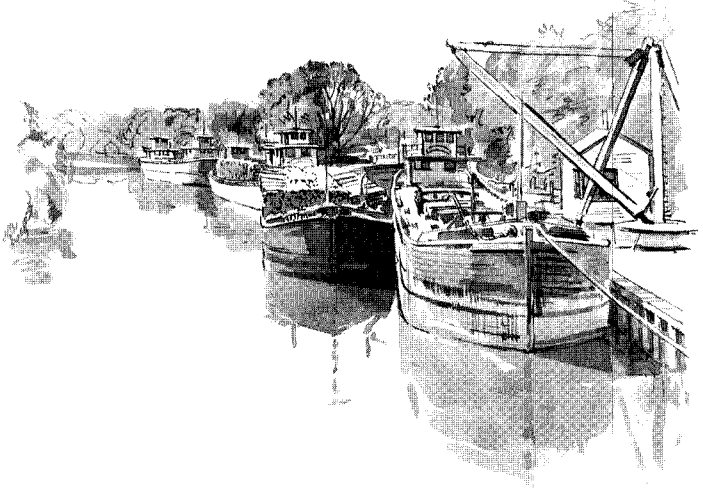
seen outside the wheelhouse of the old pumping plant at Chesapeake City:

> *"In its progress through the Eastern level large sections of embankment sunk 100 feet below the adjoining surface, and the bottom of the excavation rose 40 feet above its natural position. On the Deep Cut more than 375,000 cubic yards of earth slipped from the regulated slopes of the sides and passed into the chamber of the Canal."*

The Eastern half of the canal was put to use in 1828, a year before water was admitted to the Deep Cut. Heavily laden sloops plied the navigable 6-7 miles, the boatmen enjoying the 10-foot depth of channel, unusual in eastern canals. In the summer of 1829 the entire canal was opened for navigation, with another year needed to bring it to completion.

The canal's lower level extended 4.39 miles from the Delaware City lock to St. Georges lock; it was maintained at about elevation 7.66 above mean low water of the River at Delaware City. The entrance lock at Delaware City, somewhat protected by docks and pilings admitted vessels directly from the Delaware River. It had a lift of 6 to 8 feet, although its chamber afforded an ungated passage with a good tide. St. Georges lock provided an 8-foot lift to the summit level, which extended 9.32 miles to the western terminus at Chesapeake, (later Chesapeake City). The Chesapeake or Maryland lock was just over 1-3/4 miles west of the Delaware-Maryland state line and lowered vessels an average 16 feet from summit level to tidal Back Creek. All of the locks were 100 feet long and 22 feet wide, of masonry rubble construction over grouted timber cribbing, resting on a puddled base. They probably were originally gated at both ends by balance beam miter gates, as this type was popular with Erie engineers. Drop or fall gates, developed by Josiah White on the Lehigh Canal, were later adopted to enclose the lock chambers at the high level ends.

Water supply, the great bugaboo of canal engineers, soon became a major problem for



Barges unloading cordwood near Delaware City.

the C&D. Initially, the sumit level was replenished by natural watercourses along the route, trained to flow by gravity into the channel. Vagaries of the seasons, from droughts to floods and washouts made it imperative to seek a new supply. Then, too, traffic was increasing annually, requiring greater quantities of water to flood the locks. In 1837 a steam pump was installed at Chesapeake City in a stone building erected for the purpose. Scant knowledge is available as to the exact nature of this engine. A personal recollection of the period described it as a "large horizontal pumping engine, the cylinder and pump of which were in line on the same rod but with a flywheel and crank to measure out the stroke,"[4] apparently a contemporary locomotive type with firebox, boiler and cylinder combined.

While annual tonnage for the year ending June 1, 1837 was 100,000 tons, a decrease of 14,680 tons from 1836, an increase was recorded in passages through the canal from 2,467 to 5,433. Tonnage figures stepped up the following year and increased at a fairly consistent rate through the 1840's. Tolls were high and were so regarded down to the last days of the Lock Canal. Up to 1837 little competition was offered by the railroads and vessels of numerous types streamed through in increasing numbers. Cargoes included virtually every item of human necessity. Those which added the most volume to tonnage statistics were cord wood, lumber, flour, wheat, corn, cotton, iron, oysters, fish and whiskey. Passenger packets tallied 1,232 passages through the canal in the first year of operation, accounting for one fifth of total transits. Regular passenger service was soon established between Philadelphia and Baltimore, with stops at half-a-dozen intermediate points. The Philadelphia & Baltimore Steamboat Co., organized in 1844, initiated a day-night passenger and freight service with its new Ericsson Line of screw propellers. Transit of the canal was a part of their scheduled route. Freed of sidewheels, their slim hulls and shallow drafts were fitted to the locks. Figures for 1844 indicate a continuing traffic increase: 8,413 vessels passed through; 188,410 tons were hauled. A rival line, The Frenchtown and Newcastle Railroad, with steamboat connections at Elk River for Baltimore and at Delaware River for Philadelphia had been in operation for a dozen years. Its swifter overland service probably competed for the canal's passenger business but did little to affect its swelling freight statistics. Great shots of lumber, barges with decks tiered six-high in Tidewater farm produce, and later, coal scows from the mines of Pennsylvania and Virginia kept lockkeepers busy around the clock.

Company reports for the years 1851 through 1855 show rather large sums "expended on betterments." Transits numbered 13,582 for 1851, a few thousand less then the peak[5] which would be reached in 1871. The 14-year-old pumping engine could no longer supply the water demanded. Merrick and Sons[6] of Philadelphia was engaged to install a condensing beam engine with Stevens valve gear, capable of producing 175 horsepower. It was housed in a stone building provided with boiler room and wheel house. In the latter a huge wooden liftwheel was installed to raise the water 14 feet into the summit level of the canal. The boilers were of the type used by Oliver Evans in his high pressure steam engines of 1814: riveted wrought iron tubes set

There were few hoof-prints on the towpath in 1910. Mules had given way to steam tugs which towed strings of barges across the peninsula. Steam packets maintained a passenger service which was operative a decade before the Civil War. Mechanical propulsion, long shunned by most American canals, was adopted early on the Chesapeake and Delaware.

in brickwork and underfired. Water was channelled from Back Creek into a deep well under the 12-bucket liftwheel, from there raised to an upper race which carried it into the canal at a point about 960 feet east of the lock.

The company disbursed $9,599.32 on "betterments" in 1851, the new pumping plant accounting for most of the amount. This was just a start. In 1852 the Merrick people erected machinery that got the great wheel pumping 20,000 gallons per minute at a cost of $30,659.73. In the same column for 1853-54 a total of $149,261.12 was spent for capital improvements, in this instance a complete rebuilding of the three locks. The new dimensions of the lock chambers were: Length, 220 feet; width, 24 feet; depth over the sills was 10 feet. Tonnage for 1854 went over the half-million mark.

Traffic was discontinued in winter on the C&D. The shutdowns were needed for periodic major repairs and in seasonal deference to the elements. The old engines, preserved intact at their original site bear evidence of having done rugged work. Cracks in the bed plate, patches under the crank shaft pedestals, a welded connecting rod, and a wedged-out beam strap resulted from overwork and strain and such crises as ice jams in the wheel pit, when, according to Greville Bathe, "everything was brought up standing." It being determined that a single engine was not adequate to lift the great weight of water under abnormal conditions of weather and tides, in 1854 a second engine was contracted for from Merrick & Sons and another engine house was built east of the wheel. Equipped with the Sickels expansion or cut-off valve gear, an arrangement somewhat more sophisticated than the Stevens gear, the engine effected a noticeable economy of operation. The year of its installation (1855) marked the highest annual expenditure for improvements: $219,959.23. The year also recorded the only known tragedy to occur in the pumping plant: a man working on the pistion of the second engine was killed when rigging holding up the cylinder head gave way.

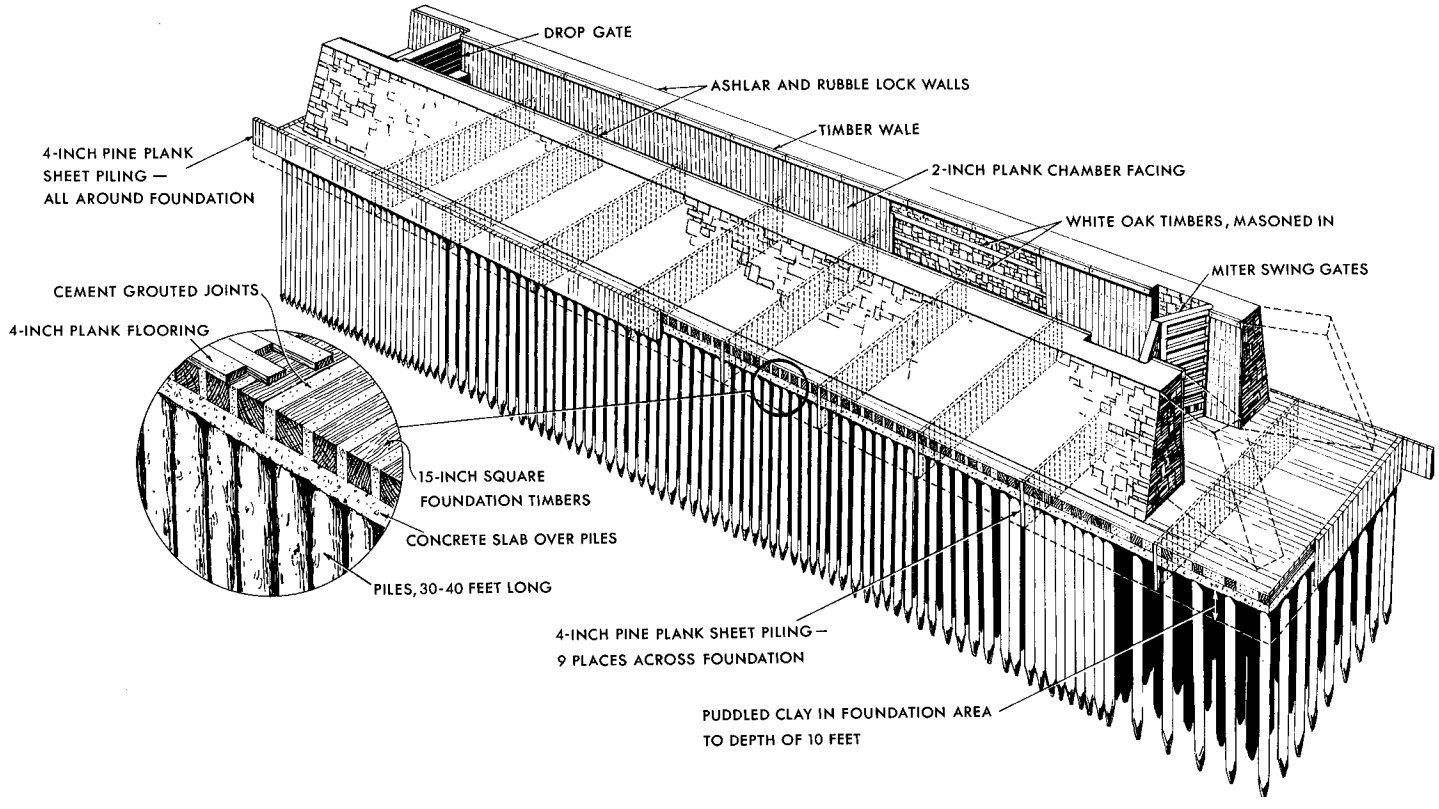
The character and extent of the canal's plant and appurtenances were now fairly established. The old wrought iron tubes were replaced in 1865 by a pair of locomotive boilers which gave 30 years of service, until in 1895 Pusey and Jones of Wilmington installed two large round return tube boilers with a combined capacity of 500 horsepower, which did duty until the plant shut down in 1927. Sometime around 1865 two Sewell direct acting steam pumps were installed in a small brick building between the engine houses. These auxiliaries were used to pump water

out of the wheel pit and to circulate cold water to the condensing system. A saving basin had been constructed adjoining the Chesapeake City lock to help relieve the heavy demand for water. Half the lock's requirements were received from this basin through a gate at the bottom, the other half through the wickets of the summit gate. On emptying, half of the lock's contents were returned to the basin.

The old canal proved its strategic military value in one memorable episode. On 17 April 1861, Virginia seceded from the Union and started her troops marching on Washington. The National Capital was undefended either by troops or fortifications. Federal troops entrained for Washington from the north were stopped in Baltimore on the nineteenth and that night all bridges from Baltimore to the Susquehanna River were destroyed by Confederation action. All seaboard rail communications to the Capital were severed.

On 20 April the Government commandeered all the propeller steamers in Philadelphia capable of negotiating the locks of the Chesapeake and Delaware Canal. The troop-laden vessels steamed down the Delaware and through the canal, arriving at Perryville, Maryland at dawn of the following morning. By rail to Baltimore, then by steamer to Annapolis and again by rail, the troops arrived in Washington as Confederate outposts arrived at the Virginia end of the Long Bridge. For the next sixty days the C&D was the vital link in a lifeline through which troops and supplies flowed to bolster the Army of the Potomac in defense of the Capital. This continued throughout the Civil War and was repeated when the C&D aided the transport of munitions in the First World War.

The locks were rebuilt in 1853-54, following installation of the liftwheel pumping plant at Chesapeake City. Together, these works comprised the most extensive capital improvement in the Canal Company's history. Capacity of the locks was more than doubled by the improvements, made at a time when railroads were bringing serious competition to waterways. The hundreds of timber piles punched into the foundations dispel all theories that the canal builders were then considering their structures as other than very permanent.



1969 view shows the edge of the sea-level canal within 40 feet of the pumphouse, its surface 14 feet lower than the old lock canal. The waters of Back Creek in the background which were once channeled into the wheelhouse and pumped up to the canal's summit level, now serve as a depot anchorage. The buildings have been designated a National Historic Site and function as a museum, in which the old liftwheel and beam engines are preserved.

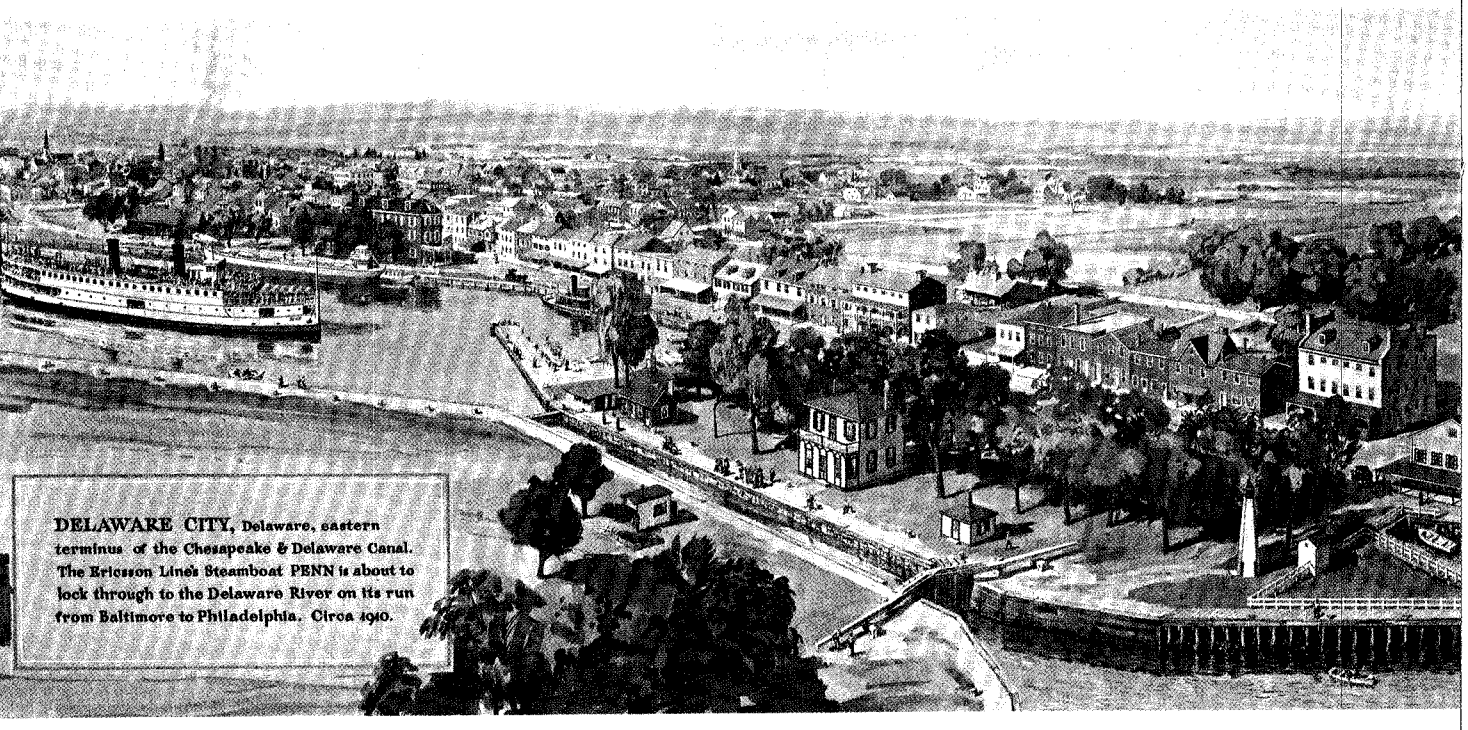
A total of $26,690.50 was expended for betterments in the year ending 1 June 1872. This was the peak year for tonnage, with 1,318,772 tons hauled, and dividends paid out amounting to $114,372.44, the highest in the canal company's history. Steam was the principal power source; horse and mule tows were becoming fewer, though a few would still be plodding the towpath after the turn of the century. Steam was also the canal's greatest rival. Railroads were spreading their vast networks across the country at a rapid pace. For the decade 1870-79 railroad mileage increased by 41,454, nearly half the United States total. The competition of rail freight was no longer an imaginary threat. In addition, eastern ports were increasing trade with Europe in larger, deeper draft vessels under steam and steam-and-sail. A line of trans-oceanic passenger steamers was making scheduled crossings. The Port of Baltimore felt the restrictions of her partially land-locked situation. The Delmarva Peninsula loomed as an obstacle to North Atlantic

navigation. In 1871 Baltimoreans petitioned Congress for a ship channel across the Peninsula.

The Chesapeake and Delaware Canal was just one of the many waterways then confronted with the decision of whether to make expensive renovations or to accept an inevitable decline. Americans were on the move and they wanted to get there faster. The meaning was clear: canals, which in more leisurely times had floated whole populations on their way to new settlements in the midwest, could not compete with smooth rails and the mania for speed.

A gradual diminution in tonnage totals is shown in annual reports following 1872. A brief recovery in the years 1882, 1883 and 1884, when figures again topped the million mark, was succeeded by progressive decline and a leveling off to around three-quarters of a million tons annually through the last years of service. The last dividend was paid in 1877: $37,618.00. The canal was then a profit-making entity in form only, its solvency becoming more precarious as installations depreciated and maintenance costs multiplied. A disastrous flood in 1874 nearly put the canal out of business. As a commercial carrier, the C&D had reached the limit of its potential.

The terminal towns, Delaware City and Chesapeake City, never saw the fulfillment of growth anticipated by their grandiose names. They were canal towns almost wholely dependent upon navigation of the waterway at their doors. They grew with the canal and with the canal's decline lapsed into the backwater status of picturesque country villages. Other waterways of the era succumbed to speed and efficiency; their channels, abandoned, became overgrown nostalgic ditches; their busy, roistering towns—sleepy hamlets. But the Chesapeake and Delaware never quite died. It never stopped operating, though it went out of business. In its transformed state as a toll-free waterway, the sea-level Chesapeake and Delaware Canal now carries the ships of the world from Bay to Bay.



DELAWARE CITY, Delaware, eastern terminus of the Chesapeake & Delaware Canal. The Ericsson Line's Steamboat PENN is about to lock through to the Delaware River on its run from Baltimore to Philadelphia. Circa 1910.